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XXX. *An Account of the Bramin's Observatory at Benares.*

*By Sir Robert Barker, Knt. F. R. S.; in a Letter to Sir John Pringle, Bart. P. R. S.*

S I R,

Read May 29, 1777. **B**ENARES in the East Indies, one of the principal seminaries of the Bramins or priests of the original Gentoos of Hindostan, continues still to be the place of resort of that sect of people; and there are many publick charities, hospitals, and pagodas, where some thousands of them now reside. Having frequently heard that the ancient Bramins had a knowledge of astronomy, and being confirmed in this by their information of an approaching eclipse both of the Sun and Moon, I made inquiry, when at that place in the year 1772, among the principal Bramins, to endeavour to get some information relative to the manner in which they were acquainted of an approaching eclipse. The most intelligent that I could meet with, however, gave me but little satisfaction. I was told, that these matters were confined to a few, who were in possession of certain books and records; some containing the mysteries

teries of their religion, and others the tables of astronomical observations, written in the Skanskirrit language, which few understood but themselves: that they would take me to a place which had been constructed for the purpose of making such observations as I was inquiring after, and from whence they supposed the learned Bramins made theirs. I was then conducted to an ancient building of stone, the lower part of which, in its present situation, was converted into a stable for horses, and a receptacle for lumber; but, by the number of court-yards and apartments, it appeared that it must once have been an edifice for the use of some public body of people. We entered this building, and went up a staircase to the top of a part of it, near to the river Ganges, that led to a large terrace, where, to my surprize and satisfaction, I saw a number of instruments yet remaining, in the greatest preservation, stupendously large, immoveable from the spot, and built of stone, some of them being upwards of twenty feet in height; and, although they are said to have been erected two hundred years ago, the graduations and divisions on the several arcs appeared as well cut, and as accurately divided, as if they had been the performance of a modern artist. The execution in the construction of these instruments exhibited a mathematical exactness in the fixing, bearing, and  
sitting

fitting of the several parts, in the necessary and sufficient supports to the very large stones that composed them, and in the joining and fastening each into the other by means of lead and iron.

The situation of the two large quadrants of the instrument marked A in the first plate, whose radius is nine feet two inches, by their being at right angles with a gnomon at twenty-five degrees elevation, are thrown into such an oblique situation as to render them the most difficult, not only to construct of such a magnitude, but to secure in their position for so long a period, and affords a striking instance of the ability of the architect in their construction; for, by the shadow of the gnomon thrown on the quadrants, they do not appear to have altered in the least from their original position; and so true is the line of the gnomon, that, by applying the eye to a small iron ring of an inch diameter at one end, the sight is carried through three others of the same dimension to the extremity at the other end, distant thirty-eight feet eight inches, without obstruction; such is the firmness and art with which this instrument has been executed. This performance is the more wonderful and extraordinary when compared with the works of the artificers of Hindostan at this day, who are not under the immediate direction

direction of an European mechanic; but arts appear to have declined equally with science in the East.

Lieutenant-colonel ARCHIBALD CAMPBELL, at that time chief engineer in the East India Company's service at Bengal, a gentleman whose abilities do honour to his profession, made a perspective drawing of the whole of the apparatus that could be brought within his eye at one view; but I lament he could not represent some very large quadrants, whose radii were about twenty feet, they being on the side from whence he took his drawing. Their description however is, that they are exact quarters of circles of different radii, the largest of which I judged to be twenty feet, constructed very exactly on the sides of stone walls built perpendicular, and situated, I suppose, in the meridian of the place: a brass pin is fixed at the center or angle of the quadrant, from whence, the Bramin informed me, they stretched a wire to the circumference when an observation was to be made; from which it occurred to me, the observer must have moved his eye up or down the circumference, by means of a ladder or some such contrivance, to raise and lower himself, until he had discovered the altitude of any of the heavenly bodies in their passage over the meridian, so expressed on the arcs of these quadrants: these arcs were very exactly divided into

nine large sections; each of which again into ten, making ninety lesser divisions or degrees; and those also into twenty, expressing three minutes each, of about two-tenths of an inch asunder; so that it is probable, they had some method of dividing even these into more minute divisions at the time of observation.

My time would only permit me to take down the particular dimensions of the most capital instrument, or the greater equinoctial Sun-dial, represented by figure A, plate 12. which appears to be an instrument to express solar time by the shadow of a gnomon upon two quadrants, one situated to the east, and the other to the west of it; and indeed the chief part of their instruments at this place appear to be constructed for the same purpose, except the quadrants, and a brass instrument that will be described hereafter.

Figure B is another instrument for the purpose of determining the exact hour of the day by the shadow of a gnomon, which stands perpendicular to and in the center of a flat circular stone, supported in an oblique situation by means of four upright stones and a cross-piece; so that the shadow of the gnomon, which is a perpendicular iron rod, is thrown upon the divisions of the circle described on the face of the flat, circular stone.

Figure c is a brass circle, about two feet diameter, moving vertically upon two pivots between two stone pillars, having an index or hand turning round horizontally on the center of this circle, which is divided into 360 parts; but there are no counter divisions on the index to sub-divide those on the circle. This instrument appears to be made for taking the angle of a star at setting or rising, or for taking the azimuth or amplitude of the Sun at rising or setting.

The use of the instrument, figure d, I was at a loss to account for. It consists of two circular walls; the outer of which is about forty feet diameter, and eight feet high; the wall within about half that height, and appears intended for a place to stand on to observe the divisions on the upper circle of the outer wall, rather than for any other purpose; and yet both circles are divided into 360 degrees, each degree being sub-divided into twenty lesser divisions, the same as the quadrants. There is a door-way to pass into the inner circle, and a pillar in the center, of the same height with the lower circle, having a hole in it, being the center of both circles, and seems to be a socket for an iron rod to be placed perpendicular into it. The divisions on these, as well as all the other instruments, will bear a nice examination with a pair of compasses.

Figure E is a smaller equinoctial Sun-dial, constructed upon the same principle as the large one A.

I cannot quit this subject without observing, that the Bramins, without the assistance of optical glasses, had nevertheless an advantage unexperienced by the observers of the more Northern climates. The serenity and clearness of the atmosphere in the night-time in the East Indies, except at the seasons of changing the monsoons or periodical winds, is difficult to express to those who have not seen it, because we have nothing in comparison to form our ideas upon: it is clear to perfection, a total quietude subsists, scarcely a cloud to be seen; and the light of the heavens, by the numerous appearance of the stars, affords a prospect both of wonder and contemplation.

This observatory at Benares is said to have been built by the order of the emperor ACKBAR; for as this wise prince endeavoured to improve the arts, so he wished also to recover the sciences of Hindostan, and therefore directed that three such places should be erected; one at Delhi, another at Agra, and the third at Benares.

Some doubts have arisen with regard to the certainty of the ancient Bramins having a knowledge in astronomy, and whether the Persians might not have introduced it into Hindostan when conquered by that people; but



but these doubts I think must vanish, when we know that the present Bramins pronounce, from the records and tables which have been handed down to them by their forefathers, the approach of the eclipses of the Sun and Moon, and regularly as they advance give timely information to the emperor and the princes in whose dominion they reside. There are yet some remains in evidence of their being at one time in possession of this science. The signs of the zodiac, in some of their Choultrys on the coast of Coromandel, as remarked by JOHN CALL, esq. F. R. S. in his letter to the Astronomer Royal, requires little other confirmation. Mr. CALL says, that as he was laying on his back, resting himself in the heat of the day, in a Choultry at Verdapetah in the Madura country, near Cape Commorin, he discovered the signs of the zodiac on the cieling of the Choultry: that he found one, equally compleat, which was on the cieling of a temple, in the middle of a Tank before the pagoda Teppecolum near Mindurah; and that he had often met with several parts in detached pieces. See *Philos. Transf.* 1772, p. 353. These buildings and temples were the places of residence and worship of the original Bramins, and bear the marks of great antiquity, having perhaps been built before the Persian conquest. Besides, when we know that the manners and customs of the Gentoo religion

religion are such as to preclude them from admitting the smallest innovation in their institutions; when we also know that their fashion in dress, and the mode of their living, have not received the least variation from the earliest account we have of them; it cannot be supposed they would engrave the symbolical figures of the Persian astronomy in their sacred temples; the signs of the zodiac must therefore have originated with them, if we credit their tradition of the purity of their religion and customs.

Mr. FRASER, in his History of the Mogul Emperors, speaking of time says, " the Lunar year they reckon " 354 days, 22 gurreis, 1 pull; the Solar year they " reckon 365 days, 15 gurreis, 30 pulls,  $22\frac{1}{2}$  peels; 60 " peels making 1 pull, 60 pulls 1 gurri, and 60 gurreis " 1 day. This is according to the Bramins or Indian " priests, and what the Moguls and other Mahomme- " dans in India chiefly go by."

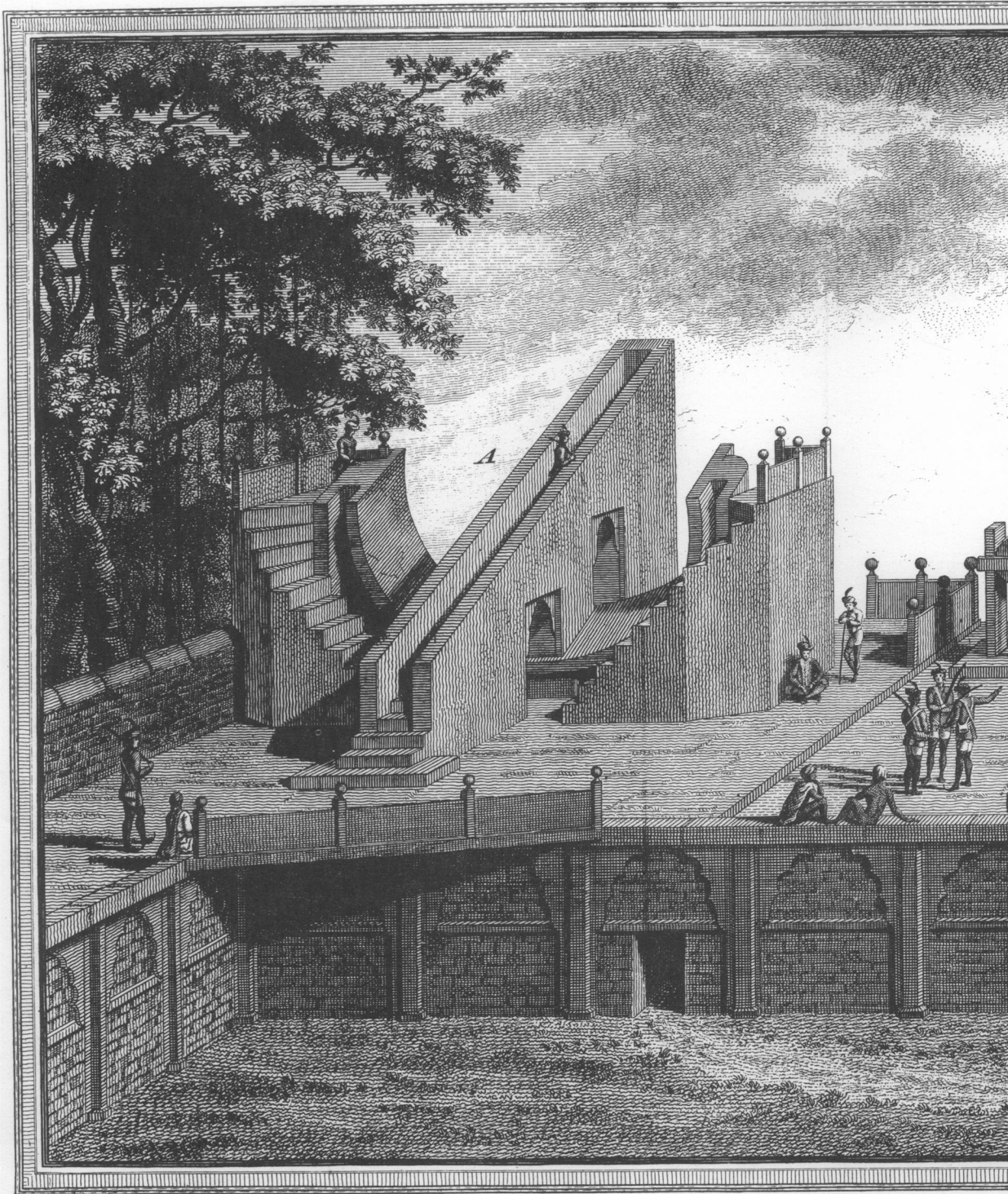
Thus far Mr. FRASER; and it serves to strengthen the argument for supposing that the Bramins had a knowledge of astronomy before the introduction of Mahometanism into Hindostan.

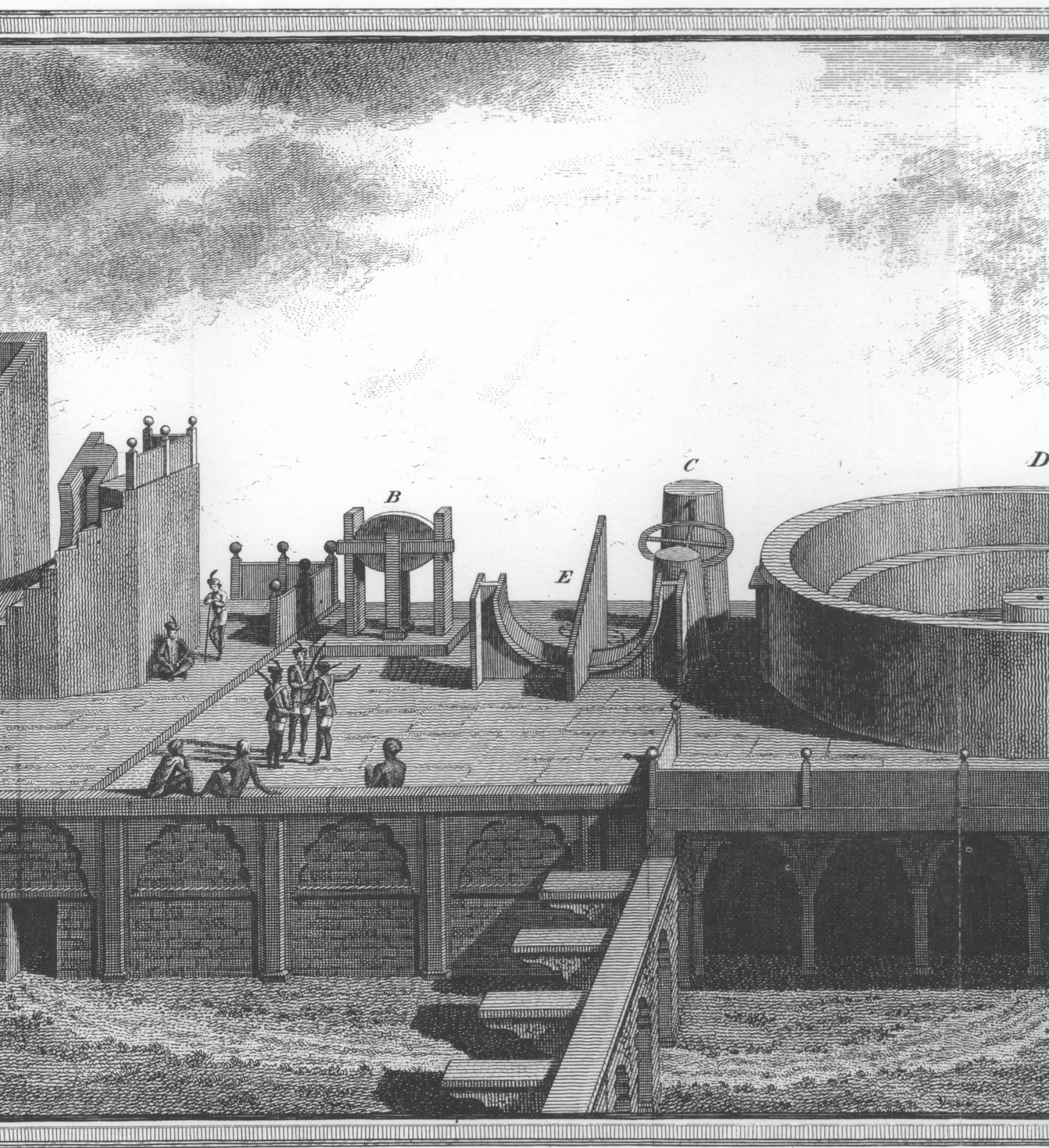
Dimensions of the larger equinoctial Sun-dial, plates  
13. and 14.

|   |   |   | Fect. | In. |
|---|---|---|-------|-----|
| Length of the gnomon at the base <i>bb</i> ,                      |   |   | 34    | 8   |
| Oblique length of the gnomon <i>cc</i> ,                          | — |   | 38    | 8   |
| Radius of the quadrants <i>aa</i> ,                               | — | — | 9     | 2   |
| Height of the gnomon at <i>d</i> ,                                | — | — | 22    | 3   |
| Breadth of the quadrants <i>ff</i> ,                              | — | — | 5     | 10  |
| Thickneſs <i>gg</i> ,   | — | — | 1     | 0   |
| Breadth of the gnomon <i>bb</i> ,                                 | — | — | 4     | 6   |
| Whole extent of the instrument <i>ii</i> ,                        | — |   | 37    | 4   |
| Latitude of the place taken by double altitude $25^{\circ} 10'$ . |   |   |       |     |

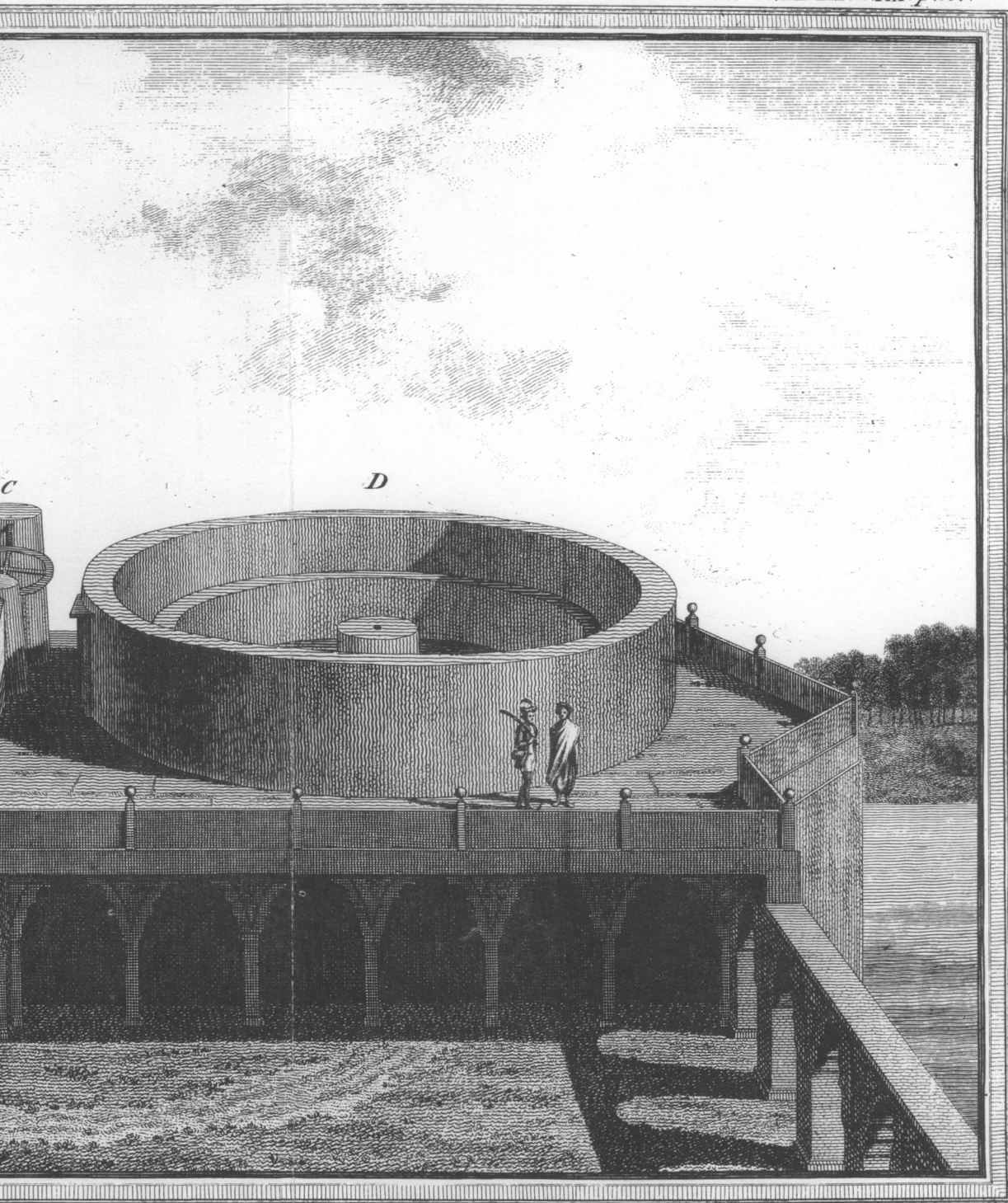
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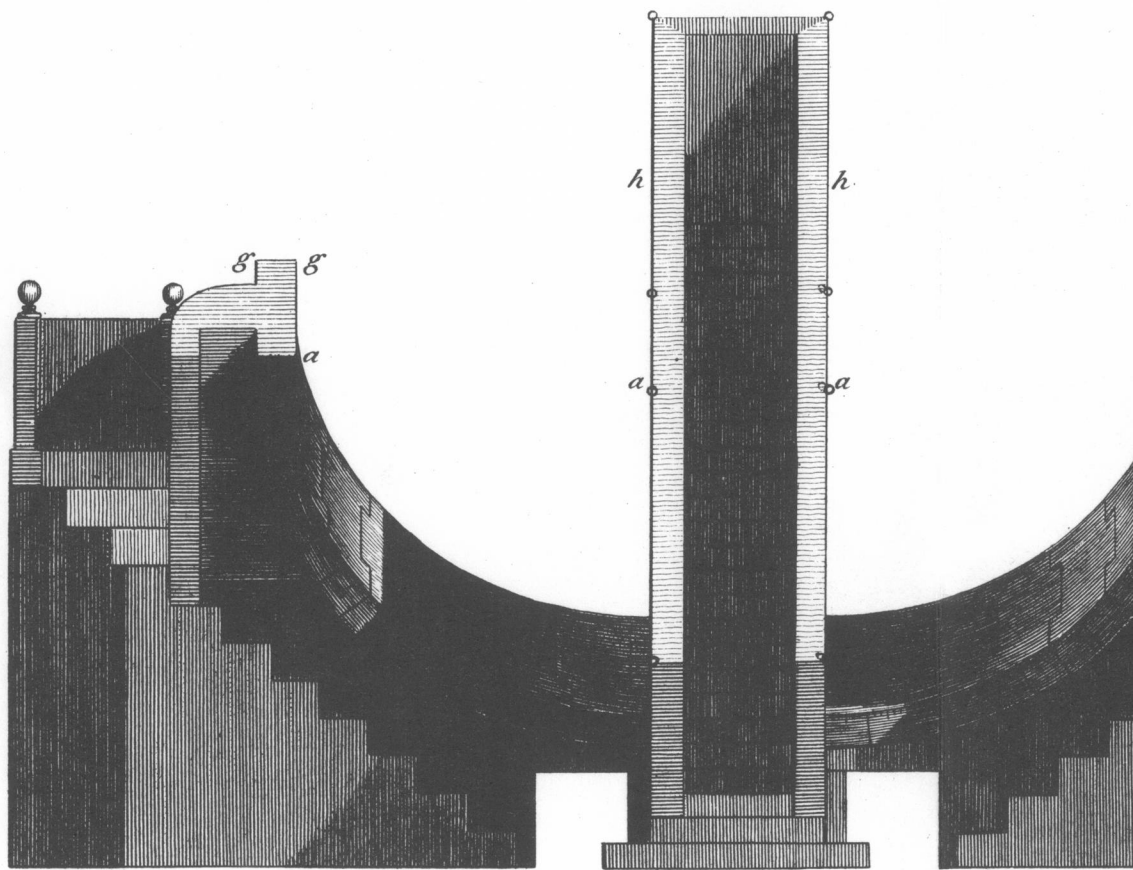


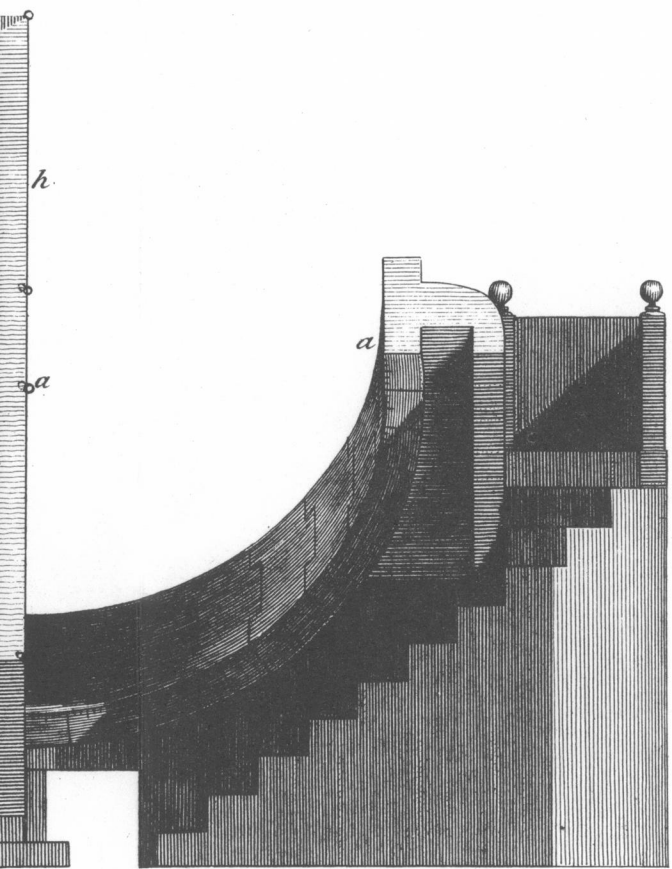












Scale of Feet.

